HH

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POWER SUPPLIES UNLIMITED

NJE CORPORATION Kenilworth, New Jersey

INSTRUCTION MANUAL

FOR

HH-LINE

HIGH VOLTAGE POWER SUPPLY

HH 30-150C D619

NJE CORPORATION
20 BORIGHT AVENUE
KENILWORTH, N. J.

Bridge 2-6000

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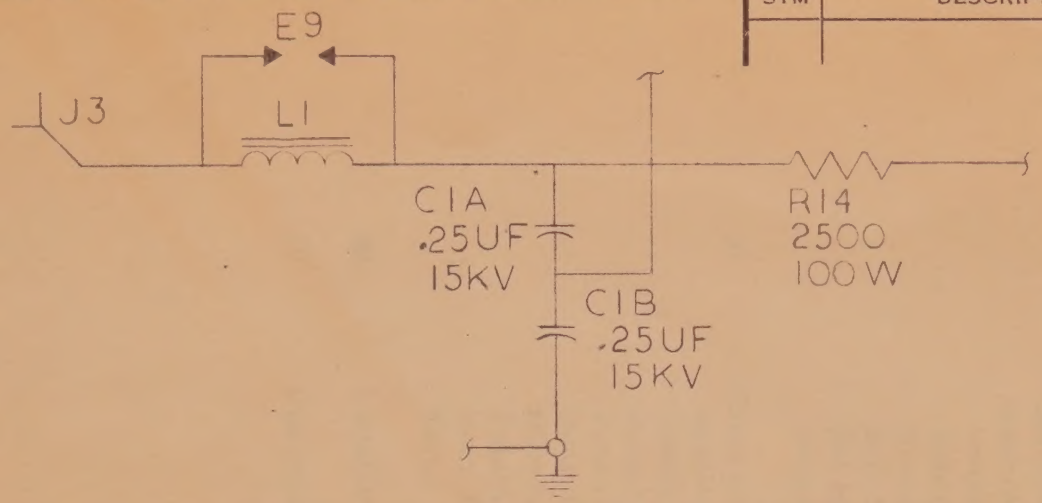

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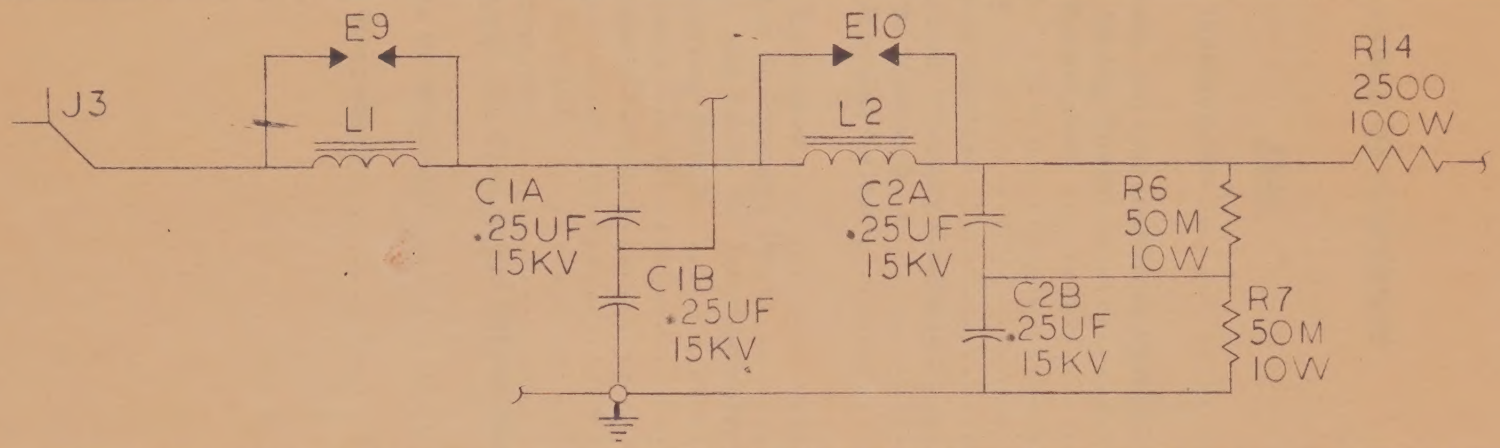

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CORRESPONDENCE AND ORDERING SPARE PARTS

1. Each NJE Power Supply has an identification label on the rear of the chassis which bears the model and serial number of the particular unit.

2. When requesting engineering data, reference should be made to the model and serial number and the component symbol number as shown on the applicable schematic.

3. When ordering spare parts, the information outlined in paragraph 2 should be given in addition to the NJE Part No. that appears on the parts list.

WARNING

THIS EQUIPMENT EMPLOYS VOLTAGES WHICH ARE DANGEROUS AND MAY BE FATAL IF CONTACTED BY OPERATING PERSONNEL. EXTREME CAUTION SHOULD BE EXERCISED WHEN WORKING WITH THIS EQUIPMENT.

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UNPACKING INSTRUCTIONS

The complete power supply shipment consists of a small carton containing the rectifier tubes, accessory parts and instruction literature, and a wooden crate containing the chassis and cabinet. (Supplies with output voltages of 50KV or higher will have an additional wooden crate, since the high voltage circuitry in these supplies is mounted separately in a steel tank to permit immersion in oil.)

Open the small carton first. Using a short, sharp knife, carefully cut the sealing tape along the center seam and the short edges of the carton top. Remove the spare instruction manual and the packing slip (in envelope) from the carton. Then remove the small parts and rectifier tubes, checking each item against the shipping list.

Open the crate (or crates) by withdrawing the nails with a nail puller or similar tool. Do not use a pinch bar or hammer, and do not pry against the equipment itself when detaching the crate sides.

As soon as the equipment is unpacked, a thorough visual inspection should be made. When the unit leaves the factory it is thoroughly checked, both electrically and mechanically, and is warranted to be in perfect operating condition. However, we cannot guarantee that no damage will be incurred during shipment. Any evidence of mishandling, such as broken, deformed or missing parts, should be brought to the attention of the shipping agency immediately, and a claim should be entered. Open the top and rear cabinet doors and inspect all components and wiring, both on the chassis and on the front panel. If the high voltage components are mounted in a separate steel tank, they can be inspected as follows:

1. Using an open-end or box wrench, remove the bolts around the perimeter of the tank cover.

2. Lift the cover and its attached frame from the tank, using a hoist if available, then rotate the assembly slightly and lower it carefully until it rests upon the top flange of the tank. If a hoist cannot be obtained, an alternate procedure is to slip screwdrivers or bars through the eye-bolts in the cover and lift the assembly far enough to permit gripping the edge of the cover. Three men will be required for this operation.

3. Inspect the components and tank carefully, then replace the assembly in the tank. Do not install the cover bolts, since

it will be necessary to open the tank again later when installing the rectifier tubes. The tank should remain covered in the interim to prevent foreign matter from entering the unit. Contamination of the transformer oil to be used in the tank can impair its insulating properties.

The packaging material should be saved until the supply has been performance tested, since the equipment should be returned in its original containers if repairs are necessary.

We strongly urge that you take time to read the entire instruction manual, before proceeding further with the assembly and installation of the equipment.

SECTION I

SPECIFICATIONS AND GENERAL DESCRIPTION

Input:	Either 115 volts ±10%, 60 cycles per second, single phase, or 208 volts ±10%, 60 cycles per second, three phase. See rating chart below.
Output:	Continuously variable from zero to rated voltage at no load to rated load conditions. See rating chart below.
Ripple:	1% RMS at any condition.
Regulation:	Line: None provided on HH models. Output voltage varies directly with line voltage. On HHMR models, line and load regulation is approximately ±0.5% from no load to full load or for ±10% line variations. Load: Less than 15% on HH models. ±0.5% from no load to full load on HHMR models.
Response Time:	The HHMR models are controlled by a motor-driven variable autotransformer to achieve the specified regulation. A 10% line change is corrected in from 2 to 2.5 seconds. A full load change is corrected in from 2 to 4 seconds. Smaller variations are corrected in proportionately less time.
Internal Resistance:	See rating chart below.
Meters:	All units are equipped with triple range voltmeters and ammeters. The voltmeter ranges are selected in the approximate ratio of 1:2:4. The ammeter ranges are selected in the approximate ratio of 1:4:10.
Housing:	See rating chart.

Controls:	Function	Component
	Main Power (on-off)	Circuit Breaker
	High Voltage Start	Push-button
	High Voltage Stop	Push-button
	High Voltage Control	Powerstat or Potentiometer
	Overcurrent or over-voltage reset	Push-button
	Overcurrent Trip Adjust	Potentiometer
	Meter polarity selector (plus - minus)	Rotary Selector switch
	Meter range selectors (2)	Rotary Selector switch
Pilot Lights:	HV Status Indicators	(Incandescent)
	HV Ready	Green
	HV ON	Red
	Overcurrent	Amber
	Overvoltage	Amber
	Main Power	Green
	Control Status Indicators (Neon)	
	Control fuse open	
	Interlock open	
	Set to "0" interlock open or zero resetting Time Delay on 60 sec.	

Duty: Continuous. Adequate ventilation and correct placement of hot-spot and high-voltage components, conservative design of all circuit elements, and self-limiting protection against brief overloads should result in a long, trouble-free life in normal industrial service.

Polarity: Choice of positive or negative ground by means of internal (readily accessible) jumper connections.

HH-LINE RATING CHART

Model	Input Voltage	Input Amperes	Output Voltage	Output Amperes	Internal Resistance	Cabinet Size W D H
HH-2.5 1000	208/220 Single Phase	15	0-2.5kv	0-1.0	250	22x18 x 68
HH-2.5 2000	208/220 Three Phase	15	0-2.5kv	0-2.0	125	22x 24 x 68
HH-5-500	208/220 Single Phase	15	0-5kv	0-0.5	1000	22x18 x 68
HH-5-1000	208/220 Three Phase	15	0-5kv	0-1.0	500	22 x 24 x 68
HH-10 250	208/220 Single Phase	15	0-10kv	0-25	4000	22 x 18
HH-10 500	208/220 Three Phase	15	0-10kv	0-.5	2000	22 x 24 x 68
HH-15 150	208/220 Single Phase	15	0-15kv	0-.15	15,000	22 x 18 x 68
HH-20-250	208/220 Three Phase	15	0-20kv	0-.25	20,000	22 x 24 x 68
HH-25 100	208/220 Single Phase	15	0-25kv	0-.10	25,000	22 x 18 x 68
HH-30 150	208/220 Three Phase	15	0-30KV	0-.15	20,000	33 x 24
HH-250 -5	115 Single Phase	30	0-250kv	0-.005	2.5meg.	22 x 18 x22 45 x 48 x 48*

* Oil Tank

GENERAL DESCRIPTION.

The HH-Line high voltage DC power supplies are designed for industrial applications where reliability and long life are important. Adequate ventilation and correct placement of hot-spot and high voltage components, conservative design of all circuit elements, and self-limiting protection against brief overloads should result in a long, trouble-free life in normal industrial service. Low corona levels are insured by proper spacing of components, and by the use of oil insulation above 30KV.

All HH-Line power supplies are built in subassemblies consisting of control sections and a high voltage section, and are housed in a deluxe relay rack type cabinet. See the rating chart for individual sizes.

The high-voltage section for 50KV and over models is housed in an oil-filled tank. This tank has been designed to provide easy servicing. An angle-iron frame is attached to the tank cover, and is used to mount the high-voltage components. When the cover is unbolted from the tank and lifted, the entire high-voltage section is removed from the oil. Port holes are provided in the cover for quick replacement of tubes, and for reversing polarity. Eyebolts in the cover allow for easy handling of the entire tank, or the frame alone. The cover is well-gasketed, enabling the unit to be moved without danger of spilling oil. A 10-foot interconnecting cable has been provided for remote operation of the high-voltage unit.

Meters: Two rectangular 4-1/2" meters are provided on the control panel. The kilovoltmeter has three ranges: 25%, 50% and 100%, approximately, of rated output voltage. The milliameter has ranges of 10%, 40% and 100%, approximately, of rated output current. These meters are hand-calibrated to 2% at the factory, and can be recalibrated at any time by screw driver-adjustable potentiometers which are part of the meter circuit.

Both meters are fully protected against overload on each range, and also when switching between ranges, by neon gaps and/or semiconductors. The kilovoltmeter reads the output voltage through a multiplier resistor connected directly to the high-voltage output terminal to assure a load voltage reading unaffected by internal regulation. The load current is measured in the ground return of the high voltage circuits. The kilovoltmeter current drain does not affect the milliammeter reading since the kilovoltmeter ground return is connected above the milliammeter in the ground return circuit.

Polarity: A pair of bus bar jumpers in the high voltage section permits reversing the polarity of the output voltage as desired.

Protective Devices: Over-voltage and over-current protective devices are provided which automatically open the primary circuit when the output voltage or current exceeds the preset cut-off value. The high-voltage is immediately shut off and appropriately identified warning lamp on the front panel is illuminated. A reset button on the panel permits restoration of the circuits to pre-operation condition after correction of the fault.

Self-Holding Primary Contactor: This device is push-button controlled, and serves to prevent the supply from automatically re-energizing after a line failure, blown fuse, overload, etc., has been corrected. When its holding circuit is interrupted, the contactor opens and will remain open until the HIGH VOLTAGE START button is pressed.

Set to "0" Interlock: This device prevents energizing the equipment, unless the voltage control knob is first turned back to zero, precluding the possibility of sudden application of high potentials. Each time the unit is energized, the output voltage will be initially zero, and must be raised to the desired potential by rotating the voltage control knob. In the case of HHMR models, the regulating system automatically resets to zero each time the unit is re-energized. The indicator lamp is labelled ZERO RESETTING.

Output Shorting Switch: Whenever the power supply is shut off, a heavy-duty gravity-operated switch immediately short-circuits the output capacitors, removing the possibility of damage or injury that might result from accidental contact with output terminals or load circuit.

SECTION II

THEORY OF OPERATION

The schematic diagram for the power supply will be found on a fold-out page at the rear of this manual. The circuit descriptions below refer to this diagram.

The heart of the power supply is the high-voltage circuitry in the central portion of the schematic diagram. All HH-Line units utilize the full-wave choke input filter bridge rectifier circuit, which includes a plate transformer T3, the rectifier tubes V1-V4 for single phase units, or V1-V6 for three phase units, and filter elements L1 and C1.

When the equipment is fully operative, power is applied to the primary of variable autotransformer T301 (T201 in some models). The adjustable output voltage is applied to the primary of plate transformer T3, which steps up this voltage to a high value and applies it to the rectifier tubes. The pulsating DC output of the rectifier stage is filtered by the LC network and applied through resistors R4, R5 and the output terminal to the external load. The series resistors R4, R5 limit the load current to a safe value in the event of an external short-circuit. Spark gaps, such as E1, are designed to short-circuit to ground any accidental discharges that may occur between the high-potential and low-potential circuitry.

The remaining circuit elements shown on the diagram are employed to control, monitor and safeguard the above high-voltage circuitry, as explained in the following paragraphs.

APPLICATION OF PRIMARY POWER. Closing the MAIN POWER circuit breaker CB301 (201 in some models) energizes the filaments of the rectifier tubes. Power is connected to the interlock circuits after a 60-second time delay. With the cabinet door interlock S13 properly closed, and the external safety interlock circuit (connected to TB1-6, 7) closed, control power is connected through the normally closed, HIGH VOLTAGE STOP-RESET push-button S103, the METER POLARITY SELECTOR switch S102A, and the normally closed contacts of the over-voltage and over-current holding relays K103 and K105, to the HIGH-VOLTAGE READY (green) indicator lamp DS106.

CONTACTOR AND SET TO "0" INTERLOCK CIRCUITS. Micro-switch S301 (201 on some models) is ganged with HIGH VOLTAGE CONTROL T301 (201 on some models), and is closed when the control knob of T301 is turned to its extreme counter-clockwise (zero) position.

If the HIGH VOLTAGE START push-button S104 is pressed when T301 is not at zero, the SET TO "0" INTERLOCK OPEN indicator lamp DS107 will light. With T301 at zero, however, S301 is closed, and the power contactor K301 (201 on some models) is energized when S104 is pressed. The holding contact of contactor K106 bypasses both S301 and S104, so that K106 and K301 remain energized after the push-button is released and the T301 control knob has been rotated away from zero position. The main contacts of K301 connect line power to the primary of autotransformer T301. The HIGH VOLTAGE ON (red) indicator lamp DS108 is energized by K106, while the opening of the normally closed contact extinguishes the HIGH VOLTAGE READY indicator DS106. The adjustable output of autotransformer T301 is applied to the primary of high-voltage transformer T3. Rotation of the T301 control knob on the front panel causes the high-voltage output to vary smoothly and continuously between zero and the rated maximum voltage.

In the HHMR models, the action is somewhat different. The circuit is so designed that when power reaches pilot light DS107, the ZERO RESETTING indicator on the HHMR units, the motor drive automatically recycles the main autotransformer T301 to zero. At this condition, the zero limit switch operates and bypasses the pilot light DS107 and brings the power to the HIGH VOLTAGE START push-button S104. The contactor and holding circuits are similar to the basic HH line units described above.

OUTPUT SHORTING SWITCH. Pressing the HIGH VOLTAGE START button also energizes relay K1, which is then held by the same holding circuit as is the main contactor K301. In the de-energized position, K1 short-circuits the high-voltage output terminals or load circuits during shutdown periods. When K1 is energized, this short circuit is removed, but since the relay armature return is gravity-operated, it stands ready to reapply the short circuit immediately upon malfunction or failure of the supply. Resistor R3 limits the short-circuit capacitor discharge current to a nondestructive value.

OVER-VOLTAGE CIRCUIT. Relay K104 is connected in series with multiplier resistor R2 and OUTPUT VOLTAGE meter M101 across the high voltage output. By mechanical adjustment this relay can be made to close its contacts when the output voltage of the supply exceeds the rated maximum by any chosen amount up to 25%. When K104 closes its contacts, the coil of relay K103 is energized. Examination of the relay circuits will show that this causes the OVER-VOLTAGE (amber) indicator lamp DS104 to light, holds the coil of K103 in energized condition, and shuts down the high voltage by de-energizing K106, K1 and K301. To restore the equipment to operation, it is then necessary to rotate the voltage control knob back to zero, press the HIGH VOLTAGE STOP-RESET button S103, and then press the HIGH VOLTAGE START push-button S104.

OVERCURRENT CIRCUIT. Relay K105 is actuated by closure of the contacts of relay K108 which is energized when the load current exceeds a set value. This value can be adjusted between 30% and 150% of the rated maximum output current by means of rheostat R106.

When K105 is energized it lights the OVERCURRENT (amber) indicator lamp DS105, establishes a hold circuit for its own coil and shuts down the high voltage circuits. After removing the cause of the excessive current drain, the equipment can be restored to operation as outlined for the over-voltage circuit above.

METERING CIRCUITS. The voltmeter is connected in series with multiplier resistors R2 and R101 direct to the high voltage output terminal, to permit monitoring the load voltage without introducing variations due to the regulation of the power supply. The voltmeter is returned to a point beyond the ammeter on the ground return, so that the current drawn by the voltmeter will not be registered on the ammeter.

The ammeter is connected in series with the ground return of the external load, and reads actual load current, rather than total supply current.

Each meter is equipped with individual shunting potentiometers for each of the three meter ranges, to permit recalibration of the meters at regular periods.

POLARITY CONTROL. On the same chassis as the high-voltage rectifier tubes are a pair of bus-bar jumpers equipped with banana plugs (P1, P2, P3, and P4) on the schematic diagram. The mating jacks for these plugs are so arranged that the bus-bars can be removed rotated 90 degrees, and reinserted to provide a reversal in output polarity. METER POLARITY SELECTOR switch S102, on the front panel is then thrown to the appropriate position, so that the meters still read up-scale for an increase in current or voltage. To avoid damage to the meters in case the switch is inadvertently thrown during normal operation, an auxiliary break-before-make contact on the switch momentarily interrupts the interlock chain, causing the supply to be shut down immediately when the switch is rotated.

NEON PROTECTORS. Neon lamps DS109 and semiconductor CR101 are connected in parallel with the voltmeter and ammeter circuits, respectively, and are inoperative except when excessive voltage appears across the devices they protect. When the voltage reaches the firing potential of the protective element, the device acts as a low impedance, and bypasses any additional currents which might otherwise damage the protected components.

MOTOR REGULATOR CIRCUIT FOR HHMR MODELS. Feedback current of approximately 2 milliamperes DC level is fed to the grid of the amplifier stage V203. This is a balanced cathode follower stage in which the reference grid is at ground potential. A pair of OA2 are used to hold the amplifier levels constant and to provide polarity reversal by returning the feedback divider network by means of the REGULATOR POLARITY SELECTOR switch S202 to either a positive or negative potential point with respect to ground.

When the output voltage varies for any reason such as a line or a load change, the balance at the grids of V203 is disturbed and the relay K203 which is the cathode follower load is energized. This is a balanced relay so that either the raise or lower contact will make in the motor drive system. The circuit is such that the "make" contact will try to restore the balance at the grids thereby providing regulating action.

Output voltage is controlled by potentiometer R205 which deliberately upsets the balance at the grids causing the regulating system to seek a new grid balancing point.

SECTION III

INSTALLATION INSTRUCTIONS

1. FOR AIR-INSULATED UNITS.

   a. Remove the masking tape used to secure the plate leads for shipment.

   b. Remove the masking tape used to secure the solenoid plunger.

   c. Install the rectifiers in their sockets, and close in the tube clamps. (Clamps not supplied for screw-in and twist-in rectifiers.)

   d. Connect the plate leads to the plate caps of the rectifier tubes.

2. FOR OIL-INSULATED UNITS.

   a. Lift the frame and cover out of the tank and set the unit down.

   b. Cut the cords used to secure the plate leads for shipment.

   c. Cut the cords used to secure the solenoid plunger.

   d. Install the rectifiers in their sockets.

   e. Connect the plate leads to the plate caps of the rectifier tubes.

   f. The tank is provided with fittings for valves, and these may be installed if desired. If not, oil may be poured in directly through the top, and pumped, syphoned, or bailed out when required.

   g. Fill the tank to the oil level line on the inside of the tank (about 2-1/2" from the top) with high grade transformer oil of at least 25KV test rating. When pouring the oil in through the top, avoid splashing as much as possible, since this causes aeration of the oil. When pumping, the oil should enter at the lower valve fitting.

   h. Install the output cable in the jack on the frame and screw the clamp fitting down on the cover.

i. Lower the frame and cover into the tank slowly to avoid splashing.

j. Bolt the lid down, using a hand wrench to tighten the bolts.

k. Screw the interconnecting cable in place at both the control chassis and tank ends.

3. Ascertain that the control-to-high voltage interconnecting cable is tight.

4. Wire terminals TB1-6 and TB1-7 to an external safety switch. This switch should be shorted in the safe-operating position. If no safety circuit is desired, then wire in a jumper across these terminals.

5. Check that the door interlock plug is properly seated.

6. Wire TB1 to a source of input power as specified on the schematic diagram. Connect a good external ground to TB1-5. #12 gauge wire is adequate for all HH-Line supplies.

7. BE SURE TO GROUND THE EQUIPMENT TO A GOOD EXTERNAL GROUND at TB1 and also at ground stud on the cabinet. Use at least 12 gauge wire.

8. a. Set the output voltage polarity jumpers as desired.

b. Set the front panel METER POLARITY SELECTOR switch accordingly.

c. Set the REGULATOR POLARITY SELECTOR accordingly on HHMR models.

9. Set the OVERCURRENT TRIP ADJUST on the front panel to the desired tripping value. The control is linear in terms of percentage of maximum rated supply current.

10. Over-voltage adjustment is made directly on the relay K104. Increase the torsion of the helical spring for higher voltage trip-out; reduce the torsion for lower voltage trip-out. Use a small open-end lug wrench for the adjustment. Make rotations of approximately 1/8 turn; then check to see if desired tripping voltage has been attained. When checking for trip voltage, it is necessary to turn the OUTPUT VOLTAGE CONTROL very slowly, since surges will produce an erroneous trip point. DO NOT ADJUST THE CONTACT POINTS ON THE RELAY.

SECTION IV

OPERATING PROCEDURE

NOTE

The following procedure outline assumes that the over-voltage and over-current relays have been adjusted for tripout at the proper valves, and that the output voltage polarity is correct. If these require readjustment, refer to Installation Instructions, paragraphs 8 - 10 above.

1. Connect the output cable to the load.

2. Rotate the high voltage control knob to zero position.

3. Place the MAIN POWER switch in the ON position. The green HIGH VOLTAGE READY indicator should light if the interlock circuits are properly closed and the control fuse is not blown after a 60-second time delay. These can be checked by observing front panel indicators. Check at the power line, and the HIGH VOLTAGE STOP pushbutton if the READY indicator fails to light.

4. Press and release the HIGH VOLTAGE START pushbutton. The red HIGH VOLTAGE ON indicator should light.

5. Set the METER RANGE SELECTOR switches S106 and S107 to the ranges appropriate to the intended output voltage and current.

6. Adjust the high voltage control knob to provide the desired output conditions.

7. TO SHUT DOWN THE HIGH VOLTAGE CIRCUITS, first turn the HIGH VOLTAGE CONTROL to zero. Then press and release the HIGH VOLTAGE STOP pushbutton. The HIGH VOLTAGE ON indicator should be extinguished, and the HIGH VOLTAGE READY indicator should light. This shut-down procedure should be followed during normal operation. In an emergency, however, the HIGH VOLTAGE STOP pushbutton should be pressed without hesitation. It is desirable to lower the voltage gradually when possible to avoid discharge surges in the shorting mechanism.

8. To shut down the entire equipment, place the line power switch in the OFF position.

9. OVER-VOLTAGE OR OVER-CURRENT CORRECTION. If at any time during operation, the HIGH VOLTAGE ON indicator is extinguished and the OVERVOLTAGE OR OVERCURRENT lamp lights, rotate the voltage control knob to its zero position, then press and release the HIGH VOLTAGE STOP-RESET pushbutton. The HIGH VOLTAGE READY indicator will then light. Press and release the HIGH VOLTAGE START pushbutton. If proper operating conditions have been re-established, the HIGH VOLTAGE ON indicator will light and the HIGH VOLTAGE READY indicator will be extinguished.

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CONTROL PANEL A1

CONTROL F101 5 AMP

TIME DELAY ON 60 SEC DS102

INTERLOCK OPEN DS103

METER POLARITY SELECTOR S102A

HIGH VOLTAGE STOP OVERCURRENT OR OVERVOLTAGE RESET S103

R111 100K 2W

K102A

K102

K104A

K103A

K103

DS109

S102B

S102C

K104

R112 100K 2W OVER-VOLTAGE ADJUST

OUTPUT VOLTAGE

M101

R101 350K 1W 1%

S106

R102 5M 2W

TB101 - 1 2 3 4 5 6 7 8 11

HIGH VOLTAGE SECTION

S1

P/O TB1

GRD 5

FOR EXTERNAL INTERLOCK 6 7

A2 POWER SECTION

TB301-5 TB301-6 TB301-11 TB301-7

SEE NOTE 1

K301

S301 NO COM NC

MAIN POWER

DS301

CB301

T301

CONTROL F301 20 AMP

CONTROL F302 20 AMP

CONTROL F303 20 AMP

TB301-8 TB301-9 TB301-10

K301A K301B K301C

T3-1 T3-2 T3-3

H

INPUT 208V 60 CPS 3 PH

PH. A 1 TB301-1

PH. B 2 TB301-2

PH. C 3 TB301-3

NEUT. 4 TB301-4

NO. 12

T2-1 X X X1 X1

T2-2 Y Y Y1 Y1

T2-3 Z Z Z1 Z1

NOTES:

1. N.O. CONTACT MAKES AT MINIMUM OUTPUT OF T301.
2. "H" INDICATES HIGH VOLTAGE WIRE —— INDICATES NO. 18 AWG WIRE UNLESS OTHERWISE SPECIFIED.

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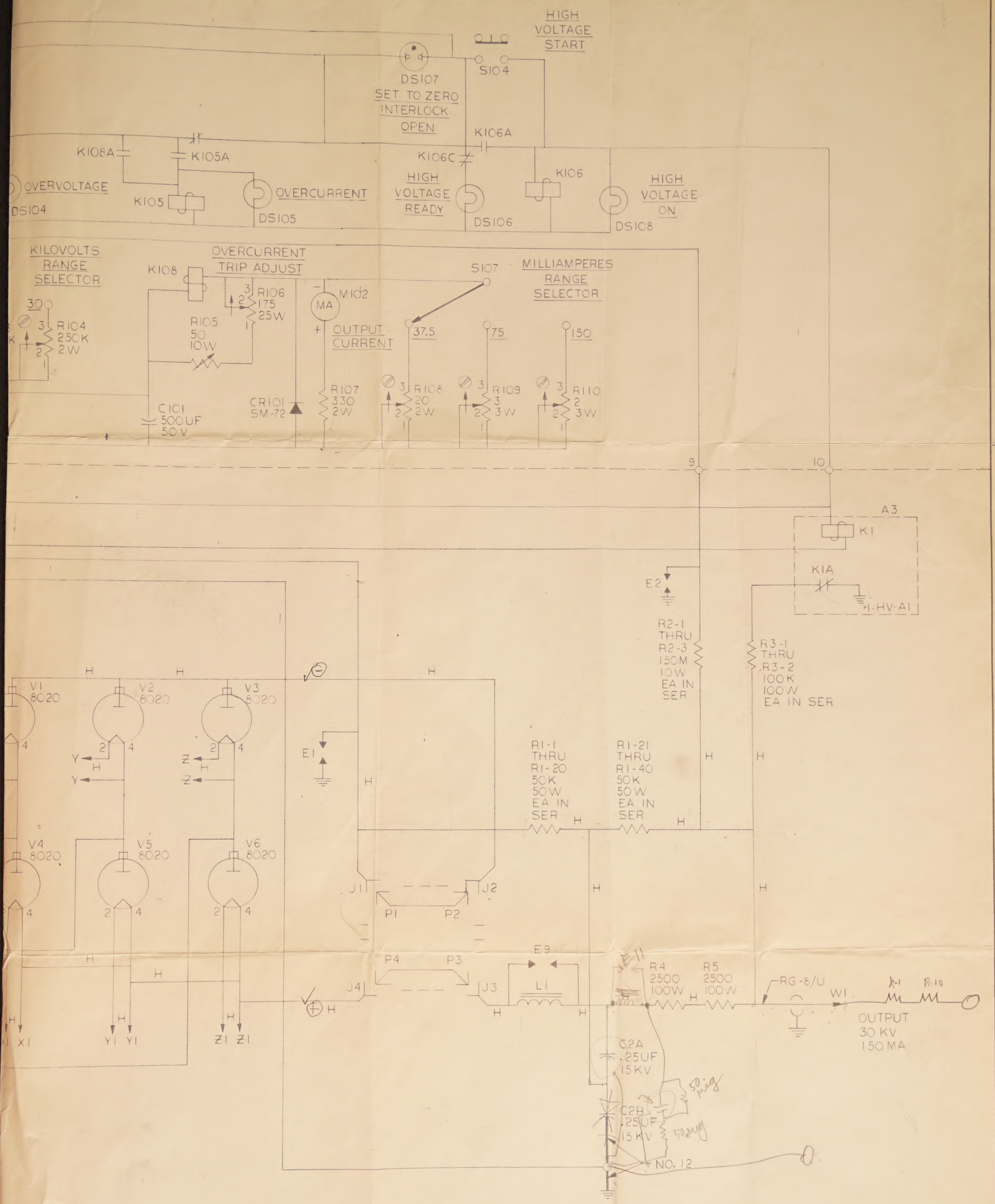

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OUR WARRANTY: N J E Corp. warrants each power supply manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replacing any defective parts thereof, except tubes, semi-conductors and fuses. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and which upon our examination is disclosed to our satisfaction to be defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started. Written permission must be obtained from the factory, before a supply may be returned for examination.

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